USING AN ISOGEOMETRIC INDIRECT BOUNDARY ELEMENT METHOD FOR STUDYING UNBOUNDED ACOUSTIC PROBLEMS CONTAINING COMPLEX GEOMETRIES

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ABSTRACT

The boundary element method is a commonly used tool in acoustic engineering for modelling products in unbounded domains. Because CAD geometries are intrinsically boundary representations, boundary element approaches lend themselves perfectly for implementation in isogeometric frameworks. In particular the indirect variational approach is of interest, allowing the modelling of problems both with open and with closed boundaries and also combined interior/exterior problems. This is an important advantage when compared to direct boundary integral formulations, since various industrial problems require the modelling of such problems. Moreover, the variational formulation leads to symmetric system matrices, which can significantly reduce the computational cost for larger models. Motivated by this, the present work uses an isogeometric indirect variational boundary element method [1] for solving steady-state acoustic problems in three dimensions. NURBS geometries are used, since the vast majority of CAD files are still NURBS-based. Unfortunately, their tensor-product structure typically requires the use of multiple patches for representing complex geometries. These multipatch configurations are often non-conforming at their interfaces, hampering a straightforward coupling of the corresponding patches. This is resolved by means of a weak master-slave coupling that enforces interface constraints resulting from fundamental relationships between NURBS basis functions and their knot-inserted versions [2]. The presented approach uses this weak coupling for ensuring C^0-continuity across patch boundaries in the employed indirect variational boundary element framework. Its accuracy and robustness are illustrated through some numerical case studies, applying the method to industrially interesting problems consisting of multiple NURBS patches, including strongly non-conforming configurations.

REFERENCES

[1] L. Coox, O. Atak, D. Vandepitte and W. Desmet, An isogeometric indirect boundary element method for solving acoustic problems in open-boundary domains, *Manuscript submitted for publication*, 2015.

[2] L. Coox, F. Greco, O. Atak, D. Vandepitte and W. Desmet, A robust patch coupling method for NURBS-based isogeometric analysis of non-conforming multipatch surfaces, *Manuscript submitted for publication*, 2016.